United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine

Importation of Chinese Penjing

into the United States

With Particular Reference to *Podocarpus macrophyllus*

2003 Supplementary Assessment

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Executive Summary

This pathway-initiated commodity risk assessment examines the risks associated with the proposed importation of penjing plants of *Podocarpus macrophyllus*, in approved growing media, from the People's Republic of China into the United States. The quarantine pests that are likely to follow the pathway are analyzed using the methodology described in the USDA, APHIS, PPQ Guidelines 5.02 which examines pest biology in the context of the Consequences of Introduction and the Likelihood of Introduction and estimates the Pest Risk Potential. The quarantine pests that can potentially follow the pathway on these plants include eleven arthropods, one mollusk, four fungi, three nematodes. The Pest Risk Potential is rated for each of the organisms and is summarized in the table below.

Pest	Pest Risk Potential
ARTHROPODA	
Neophylaphis burostris Qiao, Zhang and Cao (Homoptera: Aphididae)	High (27)
Ceroplastes japonicus Green (Homoptera: Coccidae)	High (32)
Ceroplastes pseudoceriferus Green (Homoptera: Coccidae)	High (32)
Fiorinia proboscidaria Green (Homoptera: Diaspididae)	High (30)
Lepidosaphes piniphila Borchsenius (Homoptera: Diaspididae)	High (29)
Lepidosaphes tubulorum (Ferris) (Homoptera: Diaspididae)	High (30)
Drosicha corpulenta (Kuwana) (Homoptera: Margarodidae)	High (30)
Icerya seychellarum (Westwood) (Homoptera: Margarodidae)	High (30)
Rhizoecus hibisci Kawai & Takagi (Homoptera: Pseudococcidae)	High (30)
Cryptothelea variegata Snellen (Lepidoptera: Psychidae)	High (30)
Thrips palmi Karny (Thysanoptera: Thripidae)	Medium (26)
MOLLUSCA	
Acusta ravida (Benson) (Mollusca: Bradybaenidae)	High (32)
FUNGI	
Pestalosphaeria jinggangensis P.L. Zhu, Ge, & T. Xu (Pyrenomycetes, Amphisphaeriales)	Medium (25)
Pestalotia diospyri Sydow (Fungi Imperfecti, Coelomycetes)	High (30)
Phellinus noxius (Corner) G. Cunn. (Basidiomycetes, Aphyllophorales)	High (30)
Sphaerella podocarpi Cooke (Loculoascomycetes, Dothideales)	Medium (25)
NEMATODA	
Tylenchorhynchus crassicaudatus Williams (Tylenchorhynchidae)	High (27)
Tylenchorhynchus leviterminalis Siddiqi, Mukherjee & Dasgupta (Tylenchorhynchidae)	High (28)
Xiphinema brasiliense Lordello (Xiphinematidae)	High (28)

The Pest Risk Potential for all of the arthropod, mollusk and nematode pests is High, except for *Thrips palmi* which is Medium. The Pest Risk Potential for two of the fungal pathogens is High (*Pestalotia* *diospyri* and *Phellinus noxius*), while the other two fungal pathogens (*Pestalosphaeria jinggangensis* and *Sphaerella podocarpi*) are Medium.

In this document, a number of exotic, polyphagous pests intercepted in Europe on unspecified Abonsai@ plants are assumed to be potential pests of *Podocarpus macrophyllus* (EPPO, 1996a, b). The following pests, analyzed in 1996 using the PPQ Guidelines version 4.0 criteria and then current literature, are now not considered likely to follow the pathway of the importation based on a reexamination of their reported host ranges: *Adoretus sinicus*, *Agrotis segetum*, *Amphimallon solstitialis*, *Anomala corpulenta*, *A. cupripes*, *Aporia crataegi*, *Archips oporana*, *Clania miniscula*, *Conogethes punctiferalis*, *Gypsonoma minutana*, *Gryllotalpa orientalis* (*G. africana* or *G. africans*), *Helicoverpa armigera*, *H. assulta*, *Homona coffearia*, *H. magnanima*, *Icerya aegyptiaca*, *Mamestra brassicae*, *Parlatoria pergandii*, *Phyllophaga titanis*, *Spodoptera litura*, *Sympiezomias velatus*, *Tridactylus japonicus*, and *Unaspis yanonensis* (China, 1995). Similarly, *Ceroplastes rubens*, *Cnidocampa flavescens* and *Lepidosaphes pinii*, present with limited distribution in the United States, are not analyzed.

The accompanying pest risk management document considers the reduction of risk that will occur when existing regulations on the importation of plants in APHIS-approved growing media (7 CFR ' 319.37-8) and proposed additional mitigation measures are applied to the importation of *P. macrophyllus* penjing plants in growing media from the People's Republic of China. The safeguards, presented in a separate risk mitigation document, will effectively remove the pests of concern from the pathway and allow the importation of these plants to be associated with no more pest risk than is associated with currently permitted bare-root importations.

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I. Introduction

This pest risk assessment (PRA) was conducted by the United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and Technology, Plant Epidemiology and Risk Analysis Laboratory (USDA, APHIS, PPQ, CPHST, PERAL) to examine the plant pest risks associated with the importation of artificially dwarfed plants of *Podocarpus macrophyllus* established in APHIS-approved growing medium from the People's Republic of China into the United States. The purpose of this document is to update an earlier version (Cave and Redlin, 1996).

The art of artificially dwarfing plants is a time-consuming and highly labor-intensive activity. The resulting plants range from approximately four inches to 60 inches in height, and the value may range from $10 to $10,000 per plant. The median price of an artificially dwarfed plant is close to $100 and varies with the age of the plant regardless of size. Plants imported from Asia (Japan, the People's Republic of China and the Republic of Korea) represent approximately 80 percent of the value of the entire artificially dwarfed plant market in the United States [Importation of Artificially Dwarfed Plants in Growing Media From the People's Republic of China, 65 Fed. Reg. 56803-56806 (2000) (as proposed Sept. 20, 2000) (Docket Number: 98-103-1)].

Authority for APHIS to regulate plant pests and plant products is derived from the Plant Protection Act of 2000 (7 USC §§ 7701 *et seq*.) and the Code of Federal Regulations, Title 7, Part 319, Subpart 37 (7 CFR § 319.37 - Nursery Stock, Plants, Roots, Bulbs, Seeds and Other Plant Products). The risk assessment methodology and rating criteria and the use of biological and phytosanitary terms is consistent with international guidelines (FAO, 2001, 2002; NAPPO, 1995) and current agency guidelines (APHIS, 2000).

II. Risk Assessment

A. Initiating Event: Proposed Action

This commodity-based, pathway-initiated pest risk assessment is prepared in response to a request from the Chinese Animal and Plant Quarantine Service to change current regulations to allow increased types of importations of artificially dwarfed penjing plants of *Podocarpus macrophyllus*, in APHIS-approved growing media, from China into the United States. This is a potential pathway for the introduction of plant pests. The entry of *P. macrophyllus* from China into the United States is currently regulated under 7 CFR ' 319.37, and does not explicitly prohibit the importation of naturally dwarf plants under 305 millimeters in length or artificially dwarfed plants. This lack of restrictions allows such plants to enter the United States if the plants are accompanied by a phytosanitary certificate of inspection.

The USDA carefully assesses requests to change regulations related to propagative materials because the importation of propagative material in growing media raises unique phytosanitary concerns. Specifically, biological contaminants may not be discernible during pre-shipment and Port of Entry visual inspections. This inability to non-destructively inspect all parts of the plant, may increase the potential for the introduction of exotic organisms. Treatment of growing media may not rid the media of organisms in the absence of specific guidelines, and the possibility of pest infestation/reinfestation of Aclean@ plants in the absence of specific safeguards exists.

During the past decade, China exported significant volumes of bare-root bonsai plants into the United States under the existing regulations. In August 1992, representatives of the China Animal and Plant Quarantine Service requested permission to export penjing plants established in APHIS-approved growing media. A list of 112 plant species was submitted. These plants were categorized by PPQ as Aprohibited@, Apost-entry quarantine@, and Arestricted@. In January 1994, the Chinese were asked to select five species for pest risk analysis. Subsequently, they submitted a list of eight species, and provided a list of pests or potential pests associated with these plants. In April 1994, PPQ staff identified five plant species as candidates for pest risk assessments: *Buxus sinica* (Buxaceae), *Ehretia* (*Carmona*) *microphylla* (Boraginaceae), *Podocarpus macrophyllus* (Podocarpaceae), *Sageretia thea* (*theazans)* (Rhamnaceae), and *Serissa foetida* (Rubiaceae). The risk assessment for *P. macrophyllus* was completed in September 1996. A Proposed Rule was published in 65 Fed. Reg 183 (Docket Number 00-042-1) on September 20, 2000. Compliance with the Endangered Species Act necessitated PPQ consultation with the US Fish and Wildlife Service (USFWS). Additional documentation was provided separately to the USFWS. These documentary requirements created a need to re-examine and update the original risk assessment for *P. macrophyllus*.

The updates that resulted from consultations with USFWS and that were necessary to address public comments, created a need to re-examine and update the original risk assessment for *P. macrophyllus*. This update excluded the analysis of a number of exotic, polyphagous insects, analyzed in the 1996 document. In the 1996 document, it was assumed that pests intercepted, in Europe, on unspecified "bonsai" plants could be pests of *P. macrophyllus* (EPPO, 1996a, b) due to their generalist feeding habits. Subsequent evidence showed that these pests were not likely to follow the pathway of the importation: *Adoretus sinicus*, *Agrotis segetum*, *Amphimallon solstitialis, Anomala corpulenta*, *A. cupripes, Aporia crataegi, Archips oporana, Clania miniscula, Conogethes punctiferalis, Gypsonoma minutana, Gryllotalpa orientalis, Helicoverpa armigera, H. assulta, Homona coffearia, H. magnanima, Icerya aegyptiaca, Mamestra brassicae, Parlatoria pergandii, Phyllophaga titanis, Spodoptera litura, Sympiezomias velatus, Tridactylus japonicus*, and *Unaspis yanonensis* (China, 1995).

The volume of artificially dwarfed and other dwarf plants imported into the United States increased in recent years from fewer than 600 plants in 1993 to over 54,000 plants in 1998 [Importation of Artificially Dwarfed Plants in Growing Media from the People's Republic of China, 65 Fed. Reg. 56803-56806 (2000) (as proposed Sept. 20, 2000) (Docket Number: 98-103-1)].

The Final Rule was designed to reduce the risks associated with field-collected plants that are produced quickly in their country of origin for mass export [Importation of Artificially Dwarfed Plants 67 Fed. Reg. 53727-53731 (2002) (Docket No. 00-042-2)]. These field-grown plants include species that, historically, were not imported as artificially dwarfed plants and that may not be given the same meticulous care and safeguards as traditional artificially dwarfed plants. The rule also requires that the plants are grown for at least two years in a greenhouse or screen-house in approved nurseries that are inspected annually, and that phytosanitary certificates accompany the plants. Artificially dwarfed plants grown in fields prior to their 2-

year greenhouse/screen-house growth period are required to be produced with specific safeguards to protect against infestation by longhorned beetles (Coleoptera: Cerambycidae).

B. Assessment of the Weed Potential of *Podocarpus macrophyllus*

If the species considered for import poses a risk as a weed pest, then a "pest-initiated" risk assessment is conducted. The results of the screening for weed potential for *P. macrophyllus* (Table 1) did not prompt a pest-initiated risk assessment because the evaluation concluded that there is not a significant weed potential for this species. This species has been imported, into the United States, as bare-root plants for a number of years. These plants are limited to indoor habitats and are not regularly grown outdoors in unmanaged habitats because of their strict temperature and light requirements (NRCS, 2003) (Table 1).

Table 1. Weed Potential of *Podocarpus macrophyllus*
Commodity: *Podocarpus macrophyllus* (Thunb.) Sweet (Podocarpaceae) Phase 1: There are five genera in the Podocarpaceae in the United States (*Afrocarpus, Dacrycarpus, Dacrydium, Plyllocladus* and *Podocarpus*) (NRCS, 2003). The genus *Podocarpus* consists of 73 to100 species of coniferous shrubs and trees, native to the temperate southern hemisphere mountains and highlands of the tropics, north to the West Indies and Japan. The Yew Plum Pine (*Podocarpus macrophyllus* var. *maki* Endl.) was introduced into the United States and is grown commercially. Most species can grow outdoors in zone 9 or in greenhouses as tub plants. Species grown in California include *P. gracilior* and *P. salignus* (NRCS, 2003). Phase 2: Is the genus *Podocarpus* listed in: NO Geographical Atlas of World Weeds (Holm *et al*., 1979) NO World's Worst Weeds (Holm *et al*., 1977) or World Weeds: Natural Histories and Distribution (Holm *et al*., 1997) NO Report of the Technical Committee to Evaluate Noxious Weeds; Exotic Weeds for Federal Noxious Weed Act (Gunn and Ritchie, 1982) NO Economically Important Foreign Weeds (Reed, 1977) NO Weed Science Society of America list (WSSA, 1989) NO Is there any literature reference indicating weed potential, *e.g.* AGRICOLA, CAB Biological Abstracts, AGRIS; search on "*Podocarpus*" combined with "weed"). Phase 3: The species is prevalent in the United States and there is no evidence of invasive behavior in the surveyed literature.

C. Prior Risk Assessments, Current Status and Pest Interceptions

Currently, artificially dwarfed plants of *Podocarpus* species are allowed entry as bare-root plants (7 CFR § 319.37). The risk assessment for *P. macrophyllus* in growing media was completed in September 1996, and a Proposed Rule was promulgated (65 Fed. Reg. 56803-56806 on September 20, 2000). Responses to this Proposed Rule necessitated consultations with the US Fish and Wildlife Service. Additional mitigation measures applicable to artificially dwarfed plants in growing media were promulgated in a Final Rule (67 Fed. Reg. 53727-53731 on April 19, 2002) developed in response to interceptions of beetles. All mitigation measures in 67 Fed. Reg. 53727-53731 (2002) apply to *P. macrophyllus*. Interceptions of pests on bare-root *Podocarpus* are summarized in Table 2.

Table 2. Interceptions on *Podocarpus* from the People's Republic of China, 1985-2003.		
Organism	Interception Dates[1]	Location of Interception
Colletotrichum sp.	1996	passenger baggage
Pestalotiopsis sp.	1996, 1999	permit cargo
Phoma sp.	1994	permit cargo

[1]There was one interception of each pest per year unless otherwise noted.

D. Pest Categorization

Table 3 lists the pests associated with *P. macrophyllus* that occur in China. This list identifies: (1) the presence or absence of these pests in the United States, (2) the generally affected plant part or parts, (3) any additionally important hosts, (4) the quarantine status of the pest with respect to the United States, (5) whether the pest is likely to follow the pathway to enter the United States, and (6) pertinent citations for either the distribution or the biology of the pest. Because of specific characteristics of given pest's biology and distribution, many organisms are eliminated from further consideration as sources of phytosanitary risk on *P. macrophyllus* from China because they do not satisfy the FAO definition of a quarantine pest (FAO, 2002).

Only those quarantine pests that are likely to follow the pathway are further analyzed. A quarantine pest is, "A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled" (FAO, 2002). Pests not of potential economic importance, lacking the distribution requirements, or not under official control cannot be analyzed beyond listing in Table 3 because they do not meet internationally agreed criteria (FAO, 2001). For this same reason, organisms that are not agents injurious to plants (FAO, 2002) cannot be analyzed for phytosanitary concern.

Some of the quarantine pests listed in Table 3 may be potentially detrimental to the agricultural systems of the United States. There are a variety of reasons for not subjecting them to further analysis. Examples include, but are not limited to the following: non-fertile life stages can be transported in a shipment but are unable to establish viable populations upon entry into the United States, pests can become associated with the commodity because of packing or handling procedures (biological contaminants), or the pests may be associated with the commodity but will not remain with it during transport or processing. Insects with inherent mobility (wings, legs, etc.) and/or the instinct to avoid light or human activity will not remain with the commodity. In contrast, quarantine pests that are unable to leave the commodity may have immobile or cryptic life stages and can follow the pathway.

Table 3. Pests Associated with *Podocarpus macrophyllus* in China.						
Pest	Distribution[1]	Additional Host Genera	Plant Part Affected	Quarantine Pest	Follow pathway	References
ARTHROPODA						
Acari						
Tenuipalpidae						
Brevipalpus obovatus Donnadieu	CN, US	Polyphagous[2]	Leaf	No	Yes	China, 1994; Jeppson *et al*., 1975
Insecta						
Coleoptera						
Curculionidae						
Sympiezomias velatus Chevrolet[3]	CN	Polyphagous	Whole plant	Yes	No[3]	China, 1995
Scarabaeidae						
Adoretus sinicus Burmeister[3]	CN, US (HI)	Polyphagous	Leaf, Root	Yes	No[3]	7 CFR § 318.13; China, 1995; INKTO #89
Amphimallon solstitialis (L.)[3]	CN	Polyphagous	Leaf, Root	Yes	No[3]	Browne, 1968; China, 1995; CIE, 1979; INKTO #99
Anomala corpulenta Motschulsky[3]	CN	Polyphagous	Leaf, Root	Yes	No[3]	China, 1995
Anomala cupripes Hope[3]	CN	Polyphagous	Leaf, Root	Yes	No[3]	China, 1995; Gordon, 1994; Hatsukade *et al*., 1984
Phyllophaga titanis Reitter[3]	CN	Polyphagous	Leaf, Root	Yes	No[3]	China, 1995; Gordon, 1994
Homoptera						
Aphididae						
Aphis gossypii Glover	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1995; CIE, 1968b
Neophylaphis burostris Qiao, Zhang & Cao	CN	No additional hosts	Leaf, Stem	Yes	Yes	Qiao *et al*., 2001
Neophylaphis podocarpi Takahashi	CN, US	No additional hosts	Leaf, Stem	No	Yes	China, 1994; Johnson and Lyon, 1988; Russell, 1982; Shiraki, 1952; Qiao *et al*., 2001
Cicadidae						
Cryptotympana pustulata (F.)	CN	*Citrus, Morus, Populus, Pyrus, Salix*	Root, Stem	Yes	No	China, 1994, 1995; Shiraki, 1952
Coccidae						
Ceroplastes ceriferus (Fabricius)	CN, US	Polyphagous	Leaf, Stem	No	Yes	ScaleNet, 2003

Table 3. Pests Associated with *Podocarpus macrophyllus* in China.						
Pest	Distribution[1]	Additional Host Genera	Plant Part Affected	Quarantine Pest	Follow pathway	References
Ceroplastes japonicus Green	CN	Polyphagous	Leaf, Stem	Yes	Yes	China, 1994, 1995; Gimpel, 1974; Kozar, *et al*., 1984
Ceroplastes pseudoceriferus Green	CN	Polyphagous	Leaf, Stem	Yes	Yes	China, 1994, 1995; Park *et al*., 1990
Ceroplastes rubens Maskell	CN, US (FL, HI)	Polyphagous	Leaf, Stem	No	Yes	China, 1994, 1995; Hamon and Williams, 1984; ScaleNet, 2003
Coccidae sp.	CN, US	Various	Leaf, Stem	Yes	Yes	PIN 309, 2003
Coccus hesperidum L.	CN, US	Polyphagous	Leaf, Stem	No	Yes	Browne, 1968; CIE, 1972; Hamon and Williams, 1984; ScaleNet, 2003
Coccus longulus (Douglas)	CN, US	Polyphagous	Leaf, Stem	No	Yes	Chang *et al*., 1982; Hamon and Williams, 1984
Coccus viridis (Green)	CN, US	Polyphagous	Leaf, Stem	No	Yes	ScaleNet, 2003
Pulvinaria floccifera (Westwood)	CN, US	Polyphagous	Leaf, Stem	No	Yes	ScaleNet, 2003
Diaspididae						
Aonidiella aurantii (Maskell)	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1994; CIE, 1968a; Dekle, 1965; Li and Liao, 1990; Nakahara, 1982
Aonidiella taxus Leonardi	CN, US	*Cephalotaxus*, *Taxus*	Leaf, Stem	No	Yes	China, 1994; Dekle, 1965; EPPO, 1996a; Nakahara, 1982; Qin *et al*., 1997; Uematsu, 1978
Chrysomphalus aonidum L.	CN, US	Polyphagous	Leaf, Stem	No	Yes	CIE, 1988a; Dekle, 1965
Chrysomphalus dictyospermi (Morgan)	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1994; CIE, 1969; Dekle, 1965; Garonna and Viggiani, 1989; Johnson and Lyon, 1988; Nakahara, 1982
Fiorinia fioriniae (Targioni-Tozzetti)	CN, US	Polyphagous	Leaf, Stem	No	Yes	Johnson and Lyon, 1988; Nakahara, 1982; ScaleNet, 2003

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Pest	Distribution[1]	Additional Host Genera	Plant Part Affected	Quarantine Pest	Follow pathway	References
Fiorinia japonica (Kuwana)	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1994; Johnson and Lyon, 1988; Nakahara, 1982; ScaleNet, 2003
Fiorinia pinicola Maskell	CN, US	Polyphagous	Leaf, Stem	No	Yes	ScaleNet, 2003
Fiorinia proboscidaria Green	CN, US	Polyphagous	Leaf, Stem	Yes	Yes	ScaleNet, 2003
Lepidosaphes gloverii (Packard)	CN, US	Polyphagous	Leaf, Stem	No	Yes	Dekle, 1965; Nakahara, 1982
Lepidosaphes pallida (Maskell)	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1994 Nakahara, 1982; ScaleNet, 2003
Lepidosaphes pini (Maskell)	CN, US (MD PA HI)	*Abies, Pinus*	Leaf, Stem	No	Yes	China, 1994 Nakahara 1982; ScaleNet, 2003; Xu, 1981
Lepidosaphes piniphila Borchsenius	CN	Polyphagous	Leaf, Stem	Yes	Yes	ScaleNet, 2003
Lepidosaphes tubulorum (Ferris)	CN	Polyphagous	Leaf, Stem	Yes	Yes	China, 1994; Shiraki, 1952
Parlatoria pergandii Comstock[3]	CN, US	Polyphagous	Leaf, Stem	No	No[3]	China, 1994; Dekle, 1965; Nakahara, 1982
Parlatoria proteus (Curtis)	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1994; Nakahara, 1982; ScaleNet, 2003
Parlatoria theae Cockerell	CN, US	Polyphagous	Leaf, Stem	No	Yes	ScaleNet, 2003
Phenacoccus cockerelli (Cooley)	CN, US	Polyphagous	Leaf, Stem	No	Yes	Dekle, 1965; Nakahara, 1982
Pseudaulacaspis cockerelli (Cooley)	CN, US	Polyphagous	Leaf, Stem	No	Yes	ScaleNet, 2003
Quadraspidiotus perniciosus (Comstock)	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1994; Nakahara, 1982
Unaspis yanonensis (Kuwana)[3]	CN	Polyphagous	Leaf, Stem	Yes	No[3]	China, 1994; 1995; PNKTO #45; CIE, 1988; Reu *et al*, 1990; Tanaka, 1981
Margarodidae						
Drosicha corpulenta (Kuwana)	CN	Polyphagous	Root, Stem	Yes	Yes	China, 1994, 1995; Shiraki, 1952

Table 3. Pests Associated with *Podocarpus macrophyllus* in China.						
Pest	Distribution[1]	Additional Host Genera	Plant Part Affected	Quarantine Pest	Follow pathway	References
Icerya aegyptiaca (Douglas)[3]	CN	Polyphagous	Leaf, Stem	Yes	No[3]	China, 1995; CIE, 1966; INKTO #119; Williams, 1985
Icerya seychellarum (Westwood)	CN	Polyphagous	Leaf, Stem	Yes	Yes	China, 1995; CIE, 1955; PNKTO #21
Pseudococcidae						
Rhizoecus hibisci Kawai & Takagi	CN, US (FL, HI)1	Polyphagous	Root	No[1]	Yes	EPPO, 1996a; ScaleNet, 2003
Rhizoecus sp.	CN, US	Various	Root	Yes	Yes	EPPO, 1996a
Lepidoptera						
Limacodidae						
Cnidocampa flavescens (Walker)	CN, US (MA, PA, PR)1	Polyphagous	Leaf	No1	Yes	China, 1994; EPPO, 1996b; Shiraki, 1952; Zhang, 1994
Noctuidae						
Agrotis segetum (Denis & Schiffermuller.)[3]	CN	Polyphagous	Leaf, Root, Stem	Yes	No[3]	Carter, 1984; China, 1995; INKTO #25
Helicoverpa armigera (Hübner)[3]	CN	Polyphagous	Leaf, Stem	Yes	No[3]	Avidov and Harpaz, 1969; China, 1995; CIE, 1993a; Su *et al*., 2000
Helicoverpa assulta (Guenée)[3]	CN	Polyphagous	Leaf, Stem	Yes	No[3]	China, 1995; CIE, 1994; Xie *et al*., 1998
Mamestra brassicae (L.)[3]	CN	Polyphagous	Leaf, Stem	Yes	No[3]	China, 1995; INKTO #61
Spodoptera litura (F.)[3]	CN	Polyphagous	Leaf, Root, Stem	Yes	No[3]	CIE, 1993b; China, 1995; INKTO #12
Pieridae						
Aporia crataegi L.[3]	CN	Polyphagous	Leaf	Yes	No[3]	Anon., 1972; 1986; China, 1995; INKTO #149
Psychidae						
Clania minuscula Butler[3]	CN	Polyphagous	Leaf	Yes	No[3]	China, 1994, 1995; Kozhanchikov, 1956; Shiraki, 1952
Cryptothelea variegata Snellen	CN	Polyphagous	Leaf	Yes	Yes	China, 1994, 1995
Pyralidae						

Table 3. Pests Associated with *Podocarpus macrophyllus* in China.						
Pest	Distribution[1]	Additional Host Genera	Plant Part Affected	Quarantine Pest	Follow pathway	References
Conogethes punctiferalis (Guenée)[3]	CN	Polyphagous	Leaf, Stem	Yes	No[3]	China, 1995; INKTO #19
Dioryctia splendidella Herring-Schaeffer[3]	CN	*Pinus*	Leaf, Stem	Yes	No[3]	China, 1994, 1995; Hirose and Nozato, 1975; Zelenev, 1980
Tortricidae						
Archips oporana (L.)[3]	CN	*Abies, Juniperus, Pinus*	Leaf	Yes	No[3]	Bradley *et al*., 1973; China, 1994, 1995
Gypsonoma minutana Hübner[3]	CN	*Populus, Salix*	Leaf	Yes	No[3]	China, 1994, 1995; Doganlar and Doken, 1985; Giunchi and de Giovanni, 1987
Homona coffearia Nietner[3]	CN	Polyphagous	Leaf	Yes	No[3]	Browne, 1968; China, 1994, 1995; Rejesus and Banasihan, 1978; Shiraki, 1952
Homona magnanima Diakonoff[3]	CN	Polyphagous	Leaf	Yes	No[3]	China, 1994, 1995; Kanoh *et al*., 1983; Kobayashi *et al*., 1988
Orthoptera						
Gryllotalpidae						
Gryllotalpa orientalis Burmeister (= *G. africana* Palisot de Beauvois)[3]	CN, US (HI)	Polyphagous	Root	No	No[3]	China, 1995; Hua, 2000; INKTO #197
Trydactilidae						
Tridactylus japonicus de Hoan[3]	CN	Polyphagous	Root	Yes	No[3]	China, 1995; Shiraki, 1952
Thysanoptera						
Thripidae						
Thrips palmi Karny	CN, US (American Samoa, FL, Guam, HI, PR)	Polyphagous	Leaf, Stem	Yes	Yes	CIE, 1992; CPC, 2002; Martin and Mau, 1992; Nakahara, 1994; Payne, 2003; Smith *et al*., 1992
MOLLUSCA						
Bradybaenidae						
Acusta ravida (Benson)	CN	Polyphagous	Whole plant, Soil	Yes	Yes	China, 1995; Likhachev and Rammel'meier, 1962
Bradybaena similaris (Ferussac)	CN, US	Polphagous	Whole plant, Soil	No	Yes	Chang and Chen, 1989; China, 1995; Dundee, 1970; Yen, 1943

Table 3. Pests Associated with *Podocarpus macrophyllus* in China.						
Pest	Distribution[1]	Additional Host Genera	Plant Part Affected	Quarantine Pest	Follow pathway	References
Philomycidae						
Meghimatium sp.	CN, US	Unknown	Unknown	Yes	Yes	China, 1994, 1995
BACTERIA						
Agrobacterium tumefaciens (Smith & Townsend) Conn (Rhizobiaceae)	CN, US	Various	Whole plant	No	Yes	Bradbury, l986; CPC, 2002
FUNGI						
Colletotrichum sp. (Fungi Imperfecti, Coelomycetes)	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003
Pestalosphaeria jinggangensis P.L. Zhu, Ge, & T. Xu (Ascomycetes, Xylariales)	CN	No additional hosts	Leaf	Yes	Yes	SBML, 2003; Zuh *et al*., l99la; Zuh *et al*., 1991b
Pestalotia diospyri Sydow (Fungi Imperfecti, Coelomycetes)	CN	*Diospyros, Euonymous, Rhus, Smilax*	Leaf	Yes	Yes	Anon., 1986; SBML, 2003; Tai, 1979
Pestalotia zahlbruckneriana Henn. (Fungi Imperfecti, Coelomycetes)	CN, US	*Acer, Cornus, Eucalyptus, Psidium, Rhizophora*	Leaf	No	Yes	SBML, 2003; Tai, 1979
Pestalotiopsis foedans (Sacc. & Ellis) Steyaert (Fungi Imperfecti, Coelomycetes)	CN, US	*Pinus, Thuja*	Leaf	No	Yes	SBML, 2003; Tai, 1979
Pestalotiopsis funerea (Desmaz.) Steyaert (Fungi Imperfecti, Coelomycetes)	CN, US	Numerous	Bark, Cones, Leaf, Stem	No	Yes	China, 1994; SBML, 2003
Pestalotiopsis sp. (Fungi Imperfecti, Coelomycetes)	CN, US	Numerous	Leaf	Yes	Yes	PIN 309, 2003
Phellinus noxius (Corner) Cunn. (Basidiomycetes, Aphyllophorales)	CN	Numerous	Root, Stem	Yes	Yes	Abe *et al*., 1995; Chang, 1995; SBML, 2003
Phoma sp. (Fungi Imperfecti, Coelomycetes)	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003
Phyllosticta nandinae Tassi (Fungi Imperfecti, Coelomycetes)	CN, US	*Nandina*	Leaf	No	Yes	China, 1994; SBML, 2003
Pseudomassaria carolinensis Barr & C. S. Hodges Anamorph: *Beltraniella portoricensis* (F. Stevens) Pirozynski & S. D. Patil (Ascomycetes, Xylariales)	CN, US	*Eucalyptus, Persea*	Leaf	No	Yes	Matsushima, l980; SBML, 2003

Table 3. Pests Associated with *Podocarpus macrophyllus* in China.						
Pest	Distribution[1]	Additional Host Genera	Plant Part Affected	Quarantine Pest	Follow pathway	References
Pythium aphanidermatum (Edson) Fitzp. (Oomycetes, Peronosporales)	CN, US	Various	Whole plant, Soil	No	Yes	China, 1994; CPC, 2002; SBML, 2003
Sphaerella podocarpi Cooke (Ascomycetes, Dothideales)	CN	No additional hosts	Leaf	Yes	Yes	SBML, 2003; Tai, 1979
Zygosporium masonii S. J. Hughes (Fungi Imperfecti, Hyphomycetes)	CN, US	*Artocarpus*, *Calophyllum*, *Juncus*, *Magnolia*	Leaf	No	Yes	Matsushima, l980; SBML, 2003
NEMATODA						
Aphelenchida						
Aphelenchoides besseyi Christie	CN, US	Polyphagous	Leaf, Root, Soil	No	Yes	Anon., 1984; EPPO, 1996a
Aphelenchus sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Dorylaimida						
Dorylaimidae sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Dorylaimus sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996b
Xiphinema brasiliense Lordello	CN[1]	Polyphagous	Root, Soil	Yes	Yes	Anon., 1984; EPPO, 1996b
Xiphinema sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a, b
Tylenchida						
Criconemella sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Helicotylenchus dihystera (Cobb) Sher.	CN, US	Polyphagous	Root, Soil	No	Yes	Anon., 1984; EPPO, 1996a, b
Helicotylenchus sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a, b
Hirschmanniella sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a, b
Meloidogyne sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996b
Paratrophurus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Pratylenchus brachyurus (Godfrey) Filipjev & Schuurmans Stekhoven	CN, US	Polyphagous	Root, Soil	No	Yes	Anon., 1984; EPPO, 1996b
Pratylenchus sp.	CN, US	Polyphagous	Root, Soil	Yes	Yes	EPPO, 1996a, b
Rotylenchus robustus (deMan) Filipjev	CN, US	Polyphagous	Root, Soil	No	Yes	EPPO, 1996b
Tylenchorhynchus sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a

Table 3. Pests Associated with *Podocarpus macrophyllus* in China.						
Pest	Distribution[1]	Additional Host Genera	Plant Part Affected	Quarantine Pest	Follow pathway	References
Tylenchorhynchus crassicaudatus Williams	CN	*Musa, Oryza, Saccharum, Sorghum*	Root, Soil	Yes	Yes	EPPO, 1996a, b; Lin and Chiu, 1971; Rodriguez and Ayala, 1977; Williams, 1960
Tylenchorhynchus leviterminalis Siddiqi, Mukherjee & Dasgupta	CN	Polyphagous	Root, Soil	Yes	Yes	EPPO, 1996a, b
Tylenchus sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Triplonchida						
Trichodorus sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a

[1] Geographic Distribution: CN - China, US - United States, FL - Florida, HI - Hawaii, MD – Maryland, PA – Pennsylvania, TX - Texas. Individual states are listed only if the pest is reported in less than five states or US territories. The organisms with limited US distribution that are likely to follow the pathway are *Ceroplastes rubens, Cnidocampa flavescens, Lepidosaphes pini, Rhizoecus hibisci* and *Thrips palmi*. See textual discussion following Table 3. Lack of analysis in this document shall not be construed as any type of indicator on future agency policy for these pests.

[2] Polyphagous means the species feeds and reproduces on multiple hosts in multiple plant families. Various means different species use a variety of hosts. When species of *Podocarpus* are the only hosts reported in the available literature, then "No additional hosts" is noted in the table.

[3] The following pests are generalist feeders: *Adoretus sinicus*, *Agrotis segetum*, *Amphimallon solstitialis*, *Anomala corpulenta, A. cupripes, Aporia crataegi, Archips oporana, Clania miniscula, Conogethes punctiferalis, Gypsonoma minutana, Gryllotalpa orientalis, Helicoverpa armigera, H. assulta, Homona coffearia, H. magnanima, Icerya aegyptiaca, Mamestra brassicae, Parlatoria pergandii, Phyllophaga titanis, Spodoptera litura, Sympiezomias velatus, Tridactylus japonicus* and *Unaspis yanonensis* (China, 1995). These were listed as pests in Chinese penjing gardens but not specifically listed as pests of *Podocarpus macrophyllus* (China, 1995). Published biological evidence validates the information supplied by the Chinese government that *Podocarpus* is not a host of these pests. In 1996, some of these pests were assessed as following the pathway due to their generalist habits, but current information shows that these pests are not likely to follow the pathway of the importation.

In documents supplied to PPQ by the Chinese government (China, 1994; 1995), *Calyptozele* was listed as a pest of *P. macrophyllus*. Subsequent search of the taxonomic and biological literature did not uncover the identity of this supposed species. Due to this unknown taxonomic status, this organism is not analyzed in this document. It is assumed that the risk associated with this organism is no greater than the highest ratings for any other pest within each category.

The interceptions on bonsai from China (EPPO, 1996a, b) do not explicitly link the host to the intercepted pest; for example, because commodities may become commingled or some pests occur as biological contaminants. However, based on reported association and in the absence of additional evidence, all intercepted pests are ascribed to *Podocarpus* in this document.

For the purposes of this document, *Ceroplastes rubens*, *Cnidocampa flavescens*, and *Lepidosaphes pini*, are not analyzed because they do not meet the internationally agreed criteria as quarantine pests (FAO, 2001). Due to their limited distributions in the United States, there is the potential for these pests to expand their ecological ranges. Because of this possibility, PPQ may, in the future, implement official control measures. *Thrips palmi* is analyzed because it is under consideration by USDA APHIS for official control (Payne, 2003).

The biological hazard of organisms not identified to the species level is not directly assessed. It is reasonable, however, to assume that the biologies of congeneric organisms are similar and can be related to organisms that are analyzed and that specific, applicable, mitigations that target biologically similar groups (similar in a phytosanitary-relevant sense: meaning similar treatments/controls apply) will apply. Further, the analysis of some species for which specific identification is known such as the nematodes *Tylenchorhynchus crassicaudatus*, *T. leviterminalis* and *Xiphinema brasiliense* reasonably encompasses the concerns posed by other, incompletely identified nematodes such as: *Aphelenchus* sp., *Paratrophurus* sp., *Criconemella* sp., *Dorylaimus* sp., *Helicotylenchus* sp., *Hirschmanniella* sp., *Meloidogyne* sp., *Pratylenchus* sp., *Trichodorus* sp., *Tylenchorhynchus* sp., *Tylenchus* sp., and *Xiphinema* sp because their biologies in terms of response to phytosanitary practices are similar. Similarly, biological information available for *Rhizoecus hibisci* is used to analyze *Rhizoecus* sp.

The nematode *Xiphinema brasiliense* was identified in Putnam County, Florida in 1959 (Lehman, 2002) and in California in 1974 (Hackney, 2003). The Society of Nematology reference to its presence in Florida may have been the same 1959 isolation (Anon., 1984). There appear to be no other reports of *X. brasilense* in the United States. For the purpose of this document, it is considered a quarantine pest because it was not reported in the United States in at least the last 25 years; additional evidence however, will lead to revisions to the current findings.

Many of the pests in Table 3 identified only to the order, family or generic level are based on either EPPO reported interceptions or PPQ interceptions from permit cargo of *P. macrophyllus*. Often the pest could not be completely identified because the intercepted life stage lacks structures that allow identification to species. In this risk assessment, this applies to the interception of Coccidae, *Rhizoecus* sp., *Colletotrichum* sp., *Pestalotiopsis* sp., *Phoma* sp., and a number of nematode genera. Lack of species identification may indicate the limits of the current taxonomic knowledge or the life stage or the quality of the specimen submitted for identification. Even if they could be identified, these pests may or may not belong to quarantine pest species. The intercepted pests identified only to higher taxa may actually belong to a non-quarantine species already addressed in the document under a species epithet, *e.g.*, the Coccidae includes non-quarantine pests like *Coccus hesperidum* and *C. viridis*. Nevertheless, quarantine action at ports will be required when incompletely identified organisms are intercepted because quarantine organisms are present in those taxa which are not present in the United States. If pests identified only to higher taxa are intercepted in the future, identified to species and found to be members of quarantinable species, then reevaluations of the risk assessment may occur.

The quarantine pests likely to follow the pathway of importation on species of *P. macrophyllus* from China and that are further analyzed in this risk assessment are summarized in Table 4.

Table 4. Quarantine Pests Likely to Follow the Pathway

ARTHROPODA *Neophylaphis burostris* Qiao, Zhang and Cao (Homoptera: Aphididae) *Ceroplastes japonicus* Green (Homoptera: Coccidae) *Ceroplastes pseudoceriferus* Green (Homoptera: Coccidae) *Fiorinia proboscidaria* Green (Homoptera: Diaspididae) *Lepidosaphes piniphila* Borchsenius (Homoptera: Diaspididae) *Lepidosaphes tubulorum* (Ferris) (Homoptera: Diaspididae) *Drosicha corpulenta* (Kuwana) (Homoptera: Margarodidae) *Icerya seychellarum* (Westwood) (Homoptera: Margarodidae) *Rhizoecus hibisci* Kawai & Takagi (Homoptera: Pseudococcidae) *Cryptothelea variegata* Snellen (Lepidoptera: Psychidae) *Thrips palmi* Karny (Thysanoptera: Thripidae)
MOLLUSCA *Acusta ravida* (Benson) (Mollusca: Bradybaenidae)
FUNGI *Pestalosphaeria jinggangensis* P.L. Zhu, Ge, & T. Xu (Pyrenomycetes, Amphisphaeriales) *Pestalotia diospyri* Sydow (Fungi Imperfecti, Coelomycetes) *Phellinus noxius* (Corner) G. Cunn. (Basidiomycetes, Aphyllophorales) *Sphaerella podocarpi* Cooke (Loculoascomycetes, Dothideales)
NEMATODA *Tylenchorhynchus crassicaudatus* Williams (Tylenchorhynchidae) *Tylenchorhynchus leviterminalis* Siddiqi, Mukherjee & Dasgupta (Tylenchorhynchidae) *Xiphinema brasiliense* Lordello (Xiphinematidae)

E. Analysis of Quarantine Pests

The undesirable consequences that may occur from the introduction of quarantine pests are assessed in this section. For each quarantine pest, the Pest Risk Potential is calculated by summing the values for the Consequences of Introduction and the Likelihood of Introduction.

The major sources of uncertainty present in this risk assessment are similar to those in other risk assessments. They include the approach used to combine risk elements (Bier, 1999; Morgan and Henrion, 1990), and the evaluation of risk by comparisons to lists of factors within the guidelines (Kaplan, 1992). To address this last source of uncertainty, the lists of factors were interpreted as illustrative and not exhaustive. This implies that additional biological information, even if not explicitly part of the criteria, can be used when it informs a rating. Sources of uncertainty in this analysis stem from the quality of the available biological information (Gallegos and Bonano, 1993), and the inherent, natural biological variation within a population of organisms (Morgan and Henrion, 1990).

Consequences of Introduction

This portion of the analysis considers negative outcomes that may occur when the quarantine pests identified as following the pathway of *Podocarpus macrophyllus* penjing plants from China are introduced into the United States. The potential consequences are evaluated using the following five Risk Elements: Climate-Host Interaction, Host Range, Dispersal Potential, Economic Impact, and Environmental Impact. These risk elements reflect the biology, host range and climatic and geographic distribution of each pest, and are supported by biological information on each of the analyzed pests. For each risk element, pests are assigned a rating of Low (1 point), Medium (2 points), or High (3 points) based on the criteria as stated in the Guidelines (APHIS, 2000). The summation of the points for each risk rating is the cumulative value for the Consequences of Introduction (Table 5). A cumulative value of 5 to 8 points is considered Low risk for the Consequences of Introduction, 9 to 12 points is Medium, and 13 to 15 points is considered High (APHIS, 2000).

Risk Element 1: Climate/Host Interaction

This risk element considers ecological zonation and the interactions of quarantine pests with their biotic and abiotic environments. When introduced into new areas, pests are expected to behave as they do in their native areas if the potential host plants and suitable climate are present. Broad availability of suitable climates and a wide distribution of suitable hosts are assumed to increase the impact of a pest introduction. The ratings for this risk element are based on the relative number of United States Plant Hardiness Zones (ARS, 1960) with potential host plants and suitable climate.

The variety of climatological regions in China corresponds to many of the climatological regions in the United States because they are at similar latitudes and range from coastal to mountainous regions (Hou, 1983). Penjing plants may be placed outdoors during favorable weather, but generally are expected to be grown indoors and/or in temperature controlled production facilities (Hartmann and Kester, 1959). It appears, therefore, that at least four US Plant Hardiness zones are suitable for population establishment by all of the pests (ARS, 1960). The risk rating of High (3) is given for each of these species for the Climate-Host Interaction Risk Element

Generally, *Thrips palmi* is subtropical to tropical in distribution, but populations in temperate climates overwinter in greenhouses and interiorscapes (CPC, 2002). It cannot survive subzero temperatures for more than a few days (Lewis, 1997). This species occurs in Asia, parts of the tropical Pacific, Africa, Australia, Japan, and South America and European greenhouses (CPC, 2002; Lewis, 1997). The U.S. populations are limited to Hawaii, southern Florida, Guam, Puerto Rico and American Samoa. These areas correspond to Plant Hardiness Zones 9-11 and under field conditions its distribution is likely to be limited to tropical areas (Capinera, 2000) or areas with mild winters (Tsai *et al*., 1995). For these reasons, the Climate/Host Interaction for this pest is Medium (2).

Risk Element 2: Host Range

The risk posed by a plant pest depends on both its ability to establish a viable, reproductive population and its potential for causing plant damage. This risk element assumes that the consequences of pest introduction are positively correlated with the pest's host range. Aggressiveness, virulence and pathogenicity also may be factors. The consequences are rated as a function of host range and consider whether the pest can attack a single species or multiple species within a single genus, a single plant family, or multiple families. The large number of hosts, in multiple plant families, attacked by these pests warrants a risk rating for Host Range of High (3) for all of the pests unless otherwise noted.

The only reported host for *Neophylaphis burostris* is *Podocarpus*, but this is a newly described species (Qiao *et al*., 2001), so the complete host range may not yet be known. Hosts for the members of the genus *Neophylaphis* (Homoptera: Aphididae) appear to be either specific species of *Podocarpus* (Russell, 1982) or specific pairings of *Agathis*, *Araucaria* or *Pilgerodendron* (Araucariaceae) with *Podocarpus*

(Blackman and Eastop, 1994) so the host range is Medium (2) to reflect this uncertainty.

Ceroplastes japonicus and *C. pseudoceriferus* feed on the following plants: *Buxus, Camellia, Cedrus, Chaenomeles, Citrus, Cycas, Cunninghamia, Diospyros, Gardenia, Ilex, Litchi, Magnolia, Malus, Mangifera, Michelia, Morus, Nandina, Nerium, Pinus, Podocarpus, Prunus, Punica, Pyrus, Rosa,* Rosaceae, *Salix*, *Ulmus* and *Ziziphus* (China, 1995; CPC, 2002; Gimpel *et al*., 1974; Kozar *et al*., 1984). *Fiorinia proboscidaria* feeds on: *Areca, Citrus, Daucus, Epipremnum, Eugenia, Fortunella, Gelonium, Mangifera, Piper, Podocarpus, Rhaphidophora, Rosa, Syzygium* and *Taxus* (ScaleNet, 2003).

Lepidosaphes piniphila feeds only on *Pinus* and *Podocarpus* (ScaleNet, 2003). *Lepidosaphes tubulorum* feeds on: *Alnus, Ardisia, Asparagus, Betula, Camellia, Castanea, Cercidiphyllum, Clethra, Cornus, Diospyros, Enkianthus, Erythrina, Ficus, Fraxinus, Hedwigia, Hydrangea, Ilex, Ligustrum, Lindera, Magnolia, Malus, Melia, Morus, Podocarpus, Populus, Prunus, Pyrus, Quercus, Rhododendron, Ribes, Rosa, Salix, Sapium, Schima, Sorbus, Syringa, Thea, Viburnum, Vitis* and *Votos* (China, 1994; ScaleNet, 2003; Shiraki, 1952).

Drosicha corpulenta feeds on: *Buxus, Castanea, Citrus, Diospyros, Ficus, Magnolia, Malus, Melia, Paulownia, Plantanus, Podocarpus, Prunus, Pyrus, Quercus, Salix, Sophora*, and *Ziziphus* (China, 1994; China, 1995; CPC, 2002; Shiraki, 1952)

Icerya seychellarum feeds on: *Acacia, Albizia, Annona, Artocarpus, Caesalpinia, Casuarina, Citrus, Cocos, Crotolaria, Eugenia, Euphorbia, Ficus, Grevillea, Magnolia, Mimosa, Persea, Psidium, Podocarpus, Pyrus* and *Rosa* (CPC, 2002).

Rhizoecus hibisci feeds on: *Buxus, Calibanus, Carex, Chusquea, Crinum, Cryptanthus, Cuphea, Dichorisandra, Dieffenbachia, Dioscorea, Hakonechloa, Hibiscus, Nerium, Pelargonium, Phoenix, Podocarpus, Rhaphis, Sabal, Sageretia, Serissa, Zelkova* and *Zingiber* (CPC, 2002).

The hosts for *Cryptothelea variegata* include *Albizia, Buxus, Capsicum*, and *Myristica* along with other plants that are not grown within the continental United States including tea, coffee and chocolate (Zhang, 1994). Additional hosts include *Casurina, Cinnamomum, Ginkgo, Manihot, Pinus, Podocarpus, Pyracantha, Malus, Rosa* and *Ulmus* (China, 1995; CPC, 2002).

Thrips palmi is reported on many members of the Cucurbitaceae, Fabaceae, and Solanaceae (CPC, 2002; Capinera, 2000; Nakahara, 1994). The host range also includes the following ornamental plants in other plant families: *Chrysanthemum, Cyclamen, Dahlia, Dianthus* and "various orchids" (Nakahara, 1994).

Snails (*Acusta ravida*) feed on foliage, flowers and fruit from various plant species, especially in greenhouses (Godan, 1983; Robinson, 2003) so identifying specific "hosts" is likely to underestimate the full range of plants that they can feed on. As an example of this diversity, a listing of plants intercepted with *Bradybaena* and *Acusta* species includes: *Aechmea, Alpinia, Anthurium, Apsidium, Asparagus, Barringtonia, Brassica, Carmona, Celtis, Crinum, Cymbidium, Durio, Echinodorus, Fagus, Ficus,* *Lammaphyllum*, *Ochna*, *Oncidium*, *Pachira*, *Phaius*, *Phalaenopsis*, *Podocarpus*, *Polyscias*, *Saeretia*, *Vanda*, *Vitis*, and *Zingiber* (PIN 309, 2003).

Hosts for *Pestalotia diospyri* include: *Diospyros, Euonymous, Podocarpus, Rhus*, and *Smilax* (SBML, 2003). It is unknown if these infections were on living tissue or if the fungus was present as a saprophyte.

Hosts of *Phellinus noxius* include: *Acacia*, *Actinodaphne, Aleurites, Alstonia, Annona, Araucaria, Artemisia, Artocarpus, Averrhoa, Bauhinia, Bischofia, Bombax, Broussonetia, Calocedrus, Calophyllum, Camellia, Cassia, Casuarina, Ceiba, Cerbera, Chamaecyparis, Chorisia, Chrysalidocarpus, Cinnamomum, Codiaeum, Coffea, Cordia, Cycas, Dalbergia, Delonix, Dimocarpus, Diospyros, Duranta, Elaeocarpus, Eriobotrya, Eucalyptus, Ficus, Firmiana, Fraxinus, Gardenia, Grevillea, Hibiscus, Hydrangea, Ipomoea, Keteleeria, Kigelia, Koelreuteria, Lactuca, Lagerstroemia, Lantana, Leucaena, Liquidambar, Litchi, Litsea, Macaranga, Machilus, Maesa, Mallotus, Melaleuca, Melia, Melicope, Melodinus, Michelia, Muntingia, Murraya, Neolitsea, Nerium, Osmanthus, Pachira, Palaquium, Persea, Pinus, Pistacia, Podocarpus, Pongamia, Prunus, Pterocarpus, Pyrus, Rhododendron, Roystonea, Salix, Sauranja, Schefflera, Sterculia, Swietenia, Syzygium, Tabebuia, Taiwania, Terminalia, Ulmus, Urena, Vitis, Zelkova* (SBML, 2003).

Podocarpus is the only reported host for *Sphaerella podocarpi* and *Pestalosphaeria jinggangensis* (SBML, 2003) so the host range rating is Low (1).

The host range for *Tylenchorhynchus crassicaudatus* includes *Musa* (Zhang *et al*., 1995), *Oryza* (Lin and Chiu, 1971), *Saccharum* (Williams, 1960), and *Sorghum* (Rodriguez and Ayala, 1977). The hosts for *T. leviterminalis* include: *Canarium* (Zhang *et al*., 2002), *Dimocarpus* (Liu and Zhang, 1999), *Rosa* (Pathak and Siddiqui, 1997), *Lycopersicon* (Campos and Sturhan, 1987), *Musa* (Campos *et al*., 1987; Zhang *et al*., 1995), *Oryza* (Campos *et al*., 1987), and *Saccharum* (Talavera *et al*., 2002).

The host range for *X. brasiliense*, includes *Carica*, *Cocos*, *Piper*, *Podocarpus* (Arias *et al*., 1995), *Citrus* (Crozzoli *et al*., 1998), *Croton* (Zem, 1977), *Nicotiana*, *Mangifera*, *Theobroma* (CPC, 2002), *Prunus* and *Vitis* (Maximiniano *et al*., 1998), and *Solanum* (Charchar, 1997).

Risk Element 3: Dispersal Potential

Pests may disperse after introduction into new areas. The dispersal potential indicates how rapidly and widely the pests may spread within the importing country or region and is related to the pest's reproductive potential, inherent mobility, and external dispersal facilitation modes. Factors for rating the dispersal potential include: the presence of multiple generations per year or growing season, the relative number of offspring or propagules per generation, any inherent capabilities for rapid movement, the presence of natural barriers or enemies, and dissemination enhanced by wind, water, vectors, or human assistance.

In the United States, plants within the genus *Podocarpus* are widely distributed in temperate and subtropical regions, and grown as ornamentals (Bailey *et al*., 1976; Mabberly, 1997). Artificially dwarfed plants may be placed out-of-doors in many areas of the United States, or they may be grown as indoor ornamentals. Mobile pests that arrive could migrate to other *Podocarpus* plants or other nearby native host plants particularly if placed outdoors (Jarvis, 1992). All pests are rated High (3) for dispersal potential unless otherwise noted.

The dispersal of *Neophylaphis burostris* is assumed to be similar to *N. podocarpi* which is already present in the United States (Denmark, 1969). All stages of these pests are mobile and capable of dispersion (Blackman and Eastop, 2000).

The dispersal of scales (Homoptera: Coccinea: *e.g. Ceroplastes japonicus* and *C. pseudoceriferus, Drosicha corpulenta, Fiorinia proboscidaria, Icerya seychellarum, Lepidosaphes piniphila, Lepidosaphes tubulorum*) is mainly passive by wind, water, soil, plants and animals (Greathead, 1989; Kosztarab, 1996). The two species of *Ceroplastes* have the potential to disperse over 190 km on wind currents (Washburn and Washburn, 1984), and had only one generation per year in Korea (Jiang and Gu, 1988; Park *et al*., 1990). The egg laying capacity for *C. japonicus* was 1196 to 2094 eggs per female and for *C. pseudoceriferus* there were 1073 eggs per female in Korea (Park *et al*., 1990). In Taiwan, three generations of *C. pseudoceriferous* were reported and the number of eggs per female averaged 1445.2, 1103.5 and 1287.7 for these three generations, respectively (Wen and Lee, 1986). Dispersal of *Icerya seychellarum* is primarily in the crawler stage by wind (PNKTO #21).

Rhizoecus hibisci is associated with soil and the roots of plants (McKenzie, 1967; Hata *et al*., 1996; Kosztarab, 1996). Adults and nymphs may crawl out of pot drainage holes or be dispersed in drained water into other pots in a greenhouse (Hata *et al*., 1996; McKenzie, 1967) so local dispersal within a greenhouse can be severe and long-distance transport occurs as plants are traded in commerce (EPPO, 1996a; Hata *et al*., 1996). The dispersal potential risk rating is Medium (2).

The dispersal potential for the Lepidoptera *Cryptothelea variegata* is rated High (3) because the adults fly and are capable of producing many eggs per generation (Borror *et al*., 1989; Brown, 2003; Carter 1984).

The fecundity of *Thrips palmi* ranges from 3 to 205 eggs per female (CPC, 2002). Dispersal of adults is susceptible to wind and weather because of their small size (Martin and Mau, 1992). Thrips, in general, are believed to alternate between active wing beating in warmer temperatures and passive descent in cooler temperatures during long-distance flight (Lewis, 1997). *Thrips palmi* moves in commodities in international trade as evidenced by the high number of interceptions, particularly in cut flowers (PIN 309, 2003). This pest exhibits high reproductive potential and dispersal capability so it is rated High (3).

Snails are spread in commerce, and due to their hermaphroditism, one organism can start a population (Anon., 2003; Barker, 2002; Godan, 1983). *Acusta ravida* may lay over 600 eggs/season and is increasingly widespread, in China, because modern agricultural practices provide favorable habitats (Barker, 2002). Currently, snail infestations are of heightened concern to APHIS-PPQ because of increase in volume of transported materials and the establishment of the Channeled apple snail, *Pomacea caniculata* (Lamarck) in California and Texas (Robinson, 1999; Smith and Fowler, 2002).

Pestalosphaeria jinggangensis and *Sphaerella podocarpi* are in genera where the ascospores are forcibly discharged from fruiting structures and then dispersed by wind and rain (Agrios, 1997; Pirone, 1978; Zhu *et al*., 1991). These spores are water splashed to other plants, so dispersal of sexually produced spores to outdoor nearby plants may be more limited than for asexually produced aerial spores of either these fungi or *Pestalotia diospyri* and *Phellinus noxius* (Agrios, 1997). All of these fungi may exist as dormant spores in leaf litter and soil, and the ability of these species to live and disperse as saprophytes is unknown (Abe *et al*., 1995; Agrios, 1997; Chang, 1995; Pirone, 1978; Tavadze *et al*., 1990) .

The nematodes of concern, *Tylenchorhynchus crassicaudatus, T. leviterminalis* and *X. brasiliense*, are all migratory parasites so short-distance or local dispersal will occur when infested potted plants are placed in contact with soil (Agrios, 1997; Jones and Benson, 2001; Sikora, 1992). Long distance dispersal will occur through commerce. The dispersal potential risk rating is Low (1).

<u>Risk Element 4: Economic Impact</u>

Introduced pests cause a variety of direct and indirect economic impacts, such as reduced yield, reduced commodity value, loss of foreign or domestic markets, and non-crop impacts. Factors considered during the ranking process included whether the pest would: effect yield or commodity quality, cause plant mortality, act as a disease vector, increase costs of production including pest control costs, lower market prices, effect market availability, increase research or extension costs, or reduce recreational land use or aesthetic value. All of the pests are rated High (3) for economic impact unless otherwise noted.

Generally, the economic impact of aphids is related to their ability to vector pathogens (Pirone, 1978; Short *et al*., 2001). While evolutionary important, the host specific associations of *Neophylaphis* species on *Podocarpus* do not indicate they act as disease vectors (Blackman and Eastop, 1994). Populations of *N. podocarpi* took approximately ten years after introduction to achieve notoriety in California (Russell, 1982). Growth reduction of *Podocarpus* by of up to 30 percent was reported in 1968 (Russell, 1982). For these reasons, the risk rating is Medium (2).

Of the scale insects (Homoptera: Coccinea: *e.g. Ceroplastes japonicus* and *C. pseudoceriferus, Drosicha corpulenta, Fiorinia proboscidaria, Icerya seychellarum,* and *Lepidosaphes piniphila, Lepidosaphes tubulorum*) only *I. seychellarum* is listed an important pest of citrus, cotton, peach and pear in China (Li *et al*., 1997). *Ceroplastes japonicus* is listed as an important pest in cotton, peach and red bayberry (*Myrica rubra*) in China (Li *et al*., 1997). But “Mealybugs are one of the major problems affecting plants in greenhouses and interiorscapes” (Short *et al*., 2001) so the risk rating for each of these pests is High (3).

In the greenhouse, *Rhizoecus hibisci* is a pest of ornamentals that can cause serious damage to roots (Kawai and Takagi, 1971) but it does not appear to be damaging outside of greenhouses in Hawaii (Hata *et al*., 1996) so the rating is Medium (2).

The Lepidoptera pest is assumed to be a defoliator. The High rating for *Cryptothelea variegata* is based on this assumption and the economic importance of many of its hosts, *e.g. Pinus, Podocarpus, Pyracantha, Malus, Rosa* and *Ulmus*.

Thrips palmi severely damages vegetable crops, and is a vector of tomato spotted wilt tospovirus (CPC, 2002; Tsai *et al*., 1995). Extensive feeding by larvae and adults on leaves, stems, flowers and fruit produce scarring and deformities (Martin and Mau, 1992). Terminal growth of these crops becomes stunted, discolored and deformed (Capinera, 2000), and leaves of heavily infested plants appear silvered or bronzed (Martin and Mau, 1992). The extent of damage caused to penjing plants appears to be low because *T. palmi* is a primary pest of Cucurbitaceae, Fabaceae, and Solanaceae (CPC, 2002; Capinera, 2000; Nakahara, 1994). Control programs relying on ultra-violet reflective sheets in greenhouses may be effective in reducing populations (Lewis, 1997), but to date, overall market effects of these measures have not been examined.

Mollusk feeding reduces the visual quality of the plant, the available photosynthetic surface area, and some mollusks clip succulent plant parts (Godan, 1983; Ohlendorf, 1999; Lai, 1984). The introduction of *Bradybaena similaris* (Ferrussac) into Louisiana and other states from tropical China necessitated control treatments for this occasional citrus and garden pest (Aguirre and Poss, 2000). It is anticipated that if *A. ravida* is introduced into a new areas, there will be a need for similar control measures.

Presence of the fungal leaf-spot pathogens reduces the market value of plants when observed by potential buyers (Agrios, 1997; Pirone, 1978). Most leaf-spot causing pathogens reduce visual quality, available photosynthetic area, and plant vigor but when conditions are favorable, epidemics can severely affect production (Agrios, 1997; Jarvis, 1992; Kahn and Mathur, 1999; Pirone, 1978). A serious disease of coconut is caused by *Pestalosphaeria elaeidis* (Sathiarajan and Govindan, 1989), and spur blight of red raspberry is caused by *Sphaerella rubina* (Sackett, 1915). But economic losses were not caused by *S. ceres* in wheat (Roane *et al*., 1974). Damage caused by *Pestalotia diospyri* on Japanese persimmon (*Diospyros khaki*) in Russia also was described as serious (Tavadze *et al*., 1990), so this fungus is not expected to be merely a saprophyte on dead leaves. The fungus *Phellinus noxius* caused extensive wilt of trees in Japan (Abe *et al*., 1995), and a decline on nine tree species in Taiwan (Chang, 1995). The risk rating for the Economic Impact for the fungal pathogens is Medium (2).

Nematode infestations are cryptic and unlikely to be observed except as reduced plant vigor. Although local dispersal may lead to permanent infestations within a greenhouse or nursery (Agrios, 1997; Jones and Benson, 2001), minimal long-distance dispersal affecting all potential hosts is expected unless infected *Podocarpus* are used as landscape ornamentals and alternative hosts are nearby. Even if this occurs, minimal economic impact is likely for several reasons. First, many of the hosts are not grown throughout the continental United States, *e.g*. *Saccharum* and *Citrus*. Secondly, organic mulches and green manure may be antagonistic to nematode populations (Sikora, 1992). Third, the pantropical *X. brasiliense* (Luc and Coomans, 1992) is associated with native forest flora (Fortuner and Couturier, 1983). For these reasons, the economic impact rating for *Tylenchorhynchus crassicaudatus*, *T. leviterminalis* and *X. brasiliense* is Low (1).

Risk Element 5: Environmental Impact

The ratings for this risk element are based on three aspects. The first aspect is whether the pest appears capable of disrupting native plants based on the pest's habits exhibited within its current geographic range.

The second aspect is whether the pest's presence will stimulate the need for additional chemical or biological control programs. The third aspect is whether the pest is likely to directly or indirectly impact species listed as Threatened or Endangered (50 CFR § 17.11-12) by infesting or infecting a listed plant that is in the same genus as its hosts. When a pest is known to infest or infect other plants within the same genera, and feeding preference data does not exist with the listed plant, then the listed plant is assumed to be a potential host. For all the pests, the rating for environmental impact is High (3) unless otherwise noted.

The insect pests exhibit wide host ranges in China, but the most likely effect of many of these pests is to reduce vigor although young plants can be killed (Agrios, 1997; Carter, 1984; Borror *et al*., 1989; Hill, 1987). Sustained epidemics over time are often needed for leaf-spot pathogens to directly kill host plants (Agrios, 1997; Van der Plank, 1963). The two arthropod pests *Neophylaphis burostris* and *Lepidosaphes piniphila* are rated Medium (2) because they do not have any hosts that are in the same genera as plants that are listed as Threatened, Endangered or Candidates for listing (USFWS, 2002). Conversely, the remaining arthropod pests have hosts that are in the same genera as species that are listed as Threatened, Endangered or Candidates for listing (USFWS, 2002).

Potential hosts for *Ceroplastes japonicus* and *C. pseudoceriferus* could include the Hawaiian Endangered species *Gardenia brighamii*, *G. mannii*; the Puerto Rican populations of *Ilex cookii*, *I. sintenisii* and *Buxus vahlii*, and the Hawaiian Candidate species *G. remyi* (USFWS, 2002). The larger host range for *C. japonicus* indicates that the Endangered species *Prunus geniculata* and *Ziziphus celata* in Florida, along with the Threatened species *Quercus hinckleyi* in Texas also are potential hosts for this pest. Potential hosts for *Fiorinia proboscidaria* could include the Hawaiian Endangered species *Eugenia koolauensis*, and the *E. haematocarpa* and *E. woodburyana* populations in Puerto Rico (USFWS, 2002).

Potential hosts for *Lepidosaphes tubulorum* could include the Threatened species *Betula uber* in Virginia; the Endangered *Ilex cookii* and *I. sintenisii* in Puerto Rico; the Endangered *Lindera melissifolia* in Arkansas, Georgia, Missouri, Mississippi, North and South Carolinas; the Endangered *Prunus geniculata* in Florida; the Threatened *Quercus hinckleyi* in Texas; the Endangered *Rhododendron chapmanii* in Florida; and the Threatened *Ribes echinellum* in Florida and South Carolina (USFWS, 2002).

Potential hosts for *Drosicha corpulenta* could include the Endangered plant species: *Buxus vahlii* in Puerto Rico; *Prunus geniculata* and *Ziziphus celata* in Florida; and the Threatened *Quercus hinckleyi* in Texas (USFWS, 2002).

A potential host for *Icerya seychellarum* could include the Hawaiian Endangered *Caesalpinia kavaiense* (USFWS, 2002). The ladybird predator *Rodolia cardinalis* provides varying degrees of effectiveness against this pest, depending on geography (CPC, 2002). Effective control in Mauritius occurs via the dipteran parasite *Chryptochetum monophlebi* introduced from Madagascar in 1952 (CPC, 2002). Potential hosts for *Rhizoecus hibisci* could include: the Endangered species of *Buxus vahlii* found in Puerto Rico and the Virgin Islands; the Endangered *Carex albida* and *C. lutea* in California and North Carolina, respectively; the Threatened *C. specuicola* in Arizona and Utah; the Endangered *Hibiscus arnottianus* ssp. *immaculatus*, *H. brackenridgei*, *H. clayi*, and *H. waimeae* ssp. *hannerae* in Hawaii; and the

Candidate *H. dasycalyx* in Texas (USFWS, 2002).

Potential hosts for *Cryptothelea variegata* could include the Endangered *Buxus vahlii* in Puerto Rico, and the Endangered populations of *Manihot walkerae* in Texas (USFWS, 2002).

Potential hosts for *Thrips palmi* could include the Endangered species *Allium munzii* located in California; *Cucurbita okeechobeensis* ssp. *okeechobeensis* and *Prunus geniculata* in Florida; *Helianthus schweinitzii* in North and South Carolina; *Vigna o-wahuensis* in Hawaii; *Solanum drymophilum* in Puerto Rico; and *S. incompletum* and *S. sandwicense* in Hawaii (NatureServe, 2003). Additional potential hosts for *T. palmi* could also include the Threatened species of *H. eggertii* in Alabama, Kentucky, and Tennessee and *H. paradoxus* in New Mexico and Texas, as well as the Candidate species *S. nelsonii* in Hawaii and *H. verticillatus* in Alabama, Georgia, and Tennessee (NatureServe, 2003). The following genera of hosts (Capinera, 2000; CPC, 2002; Nakahara, 1994) for *Thrips palmi* do not have plants listed as Endangered, Threatened or Candidates for listing (USFWS, 2003): *Capsicum, Chrysanthemum, Citrus, Cucumis, Cyclamen, Dahlia, Dianthus, Glycine, Gossypium, Ipomoea, Lactuca, Lycopersicon, Mangifera, Nicotiana, Oryza, Persea, Phaseolus,* and *Sesamum*. Resistance to oxamyl and organophosphates is reported, and while methiocarb was effective in one study, it is not registered for use on vegetable crops in the United States (Martin and Mau, 1992).

The two fungal pests *Pestalosphaeria jinggangensis* and *Sphaerella podocarpi* are rated Medium (2) because they do not have any hosts that are in the same genus as plants that are listed as Threatened, Endangered or Candidates for listing (USFWS, 2002). Conversely, the other fungal pests have host plants that are in the same genera as plants that are listed as Threatened, Endangered or Candidates for listing (USFWS, 2002). A potential host plant for *Pestalotia diospyri* could include the Endangered *Rhus michuxii* in Georgia, North Carolina, South Carolina and Virginia (USFWS, 2002). Potential hosts for *Phellinus noxius* could include the 13 Endangered and 6 Candidate species of *Melicope* present in Hawaii; the Endangered species *Prunus geniculata* and *Rhododendron chapmanii* in Florida; the Endangered *Cordia bellonis* and Candidate *C. rupicola* in Puerto Rico; the Hawaiian Endangered species *Gardenia brighamii, G. mannii* and the Candidate species *G. remyi*; the Endangered *Hibiscus arnottianus* ssp. *immaculatus, H. brackenridgei, H. clayi,* and *H. waimeae* ssp. *hannerae* in Hawaii and the Candidate species *H. dasycalyx* in Texas (USFWS, 2002)

The nematode *Tylenchorhynchus crassicaudatus* is rated Medium (2) because it does not have any hosts that are in the same genera as plants that are listed as Threatened, Endangered or Candidates for listing (USFWS, 2002). Conversely, the other two nematodes have host plants that are in the same genera as plants that are listed as Threatened, Endangered or Candidates for listing (USFWS, 2002). Potential hosts for *Tylenchorhynchus leviterminalis* could include the Endangered *Euphorbia haeleeleana* in Hawaii and the Threatened *E. telephioides* in Florida (USFWS, 2002). Potential hosts for *Xiphinema brasiliense* include the Endangered *Prunus geniculata* in Florida, and the

Endangered species *Solanum drymophilum* in Puerto Rico, *S. incompletum* and *S. sandwicense* in Hawaii, and the Candidate *S. nelsonii* in Hawaii (USFWS, 2002).

Table 5. Risk Ratings for the Consequences of Introduction[1].						
Pest	Climate / Host	Host Range	Dispersal Potential	Economic Impact	Environmental Impact	Consequences of Introduction
ARTHROPODA						
Neophylaphis burostris	High (3)	Medium (2)	High (3)	Medium (2)	Medium (2)	Medium (12)
Ceroplastes japonicus	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
Ceroplastes pseudoceriferus	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
Fiorinia proboscidaria	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
Lepidosaphes piniphila	High (3)	High (3)	High (3)	High (3)	Medium (2)	High (14)
Lepidosaphes tubulorum	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
Drosicha corpulenta	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
Icerya seychellarum	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
Rhizoecus hibisci	High (3)	High (3)	Medium (2)	Medium (2)	High (3)	High (13)
Cryptothelea variegata	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
Thrips palmi	Medium (2)	High (3)	High (3)	High (3)	High (3)	High (14)
MOLLUSCA						
Acusta ravida	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
FUNGI						
Pestalosphaeria jinggangensis	High (3)	Low (1)	High (3)	Medium (2)	Medium (2)	Medium (11)
Pestalotia diospyri		High (3)			High (3)	High (14)
Phellinus noxius		High (3)			High (3)	High (14)
Sphaerella podocarpi		Low (1)			Medium (2)	Medium (11)
NEMATODA						
Tylenchorhynchus crassicaudatus	High (3)	High (3)	Low (1)	Low (1)	Medium (2)	Medium (10)
T. leviterminalis					High (3)	Medium (11)
Xiphinema brasiliense					High (3)	Medium (11)

[1] Individual ratings are presented when there is variability within a risk element, otherwise a single rating applies to all the pest organisms within that taxa for that risk element.

Likelihood of Introduction

The Likelihood of Introduction for a pest is rated relative to six factors (APHIS, 2000). The assessment rates five of these areas based on the biological features exhibited by the pest's interaction with the commodity. These areas represent a series of independent events that must all take place before a pest outbreak occurs. These five areas are: the availability of post-harvest treatments, whether the pest can survive through the interval of normal shipping procedures, whether the pest can be detected during a port of entry inspection, the likelihood that the pest will be imported or subsequently moved into a suitable environment, and the likelihood that the pest will come into contact with suitable hosts. The value for the Likelihood of Introduction is the sum of the ratings for the Quantity Imported Annually and these biologically based areas (Table 6). The following scale is used to interpret this total: Low is 6-9 points, Medium is 10-14 points and High is 15-18 points.

<u>Risk Element 6, subelement 1: Quantity Imported Annually</u>

The rating for this risk element is based on the amount reported by the country of proposed export converted into standard units of 40-foot long shipping containers (APHIS, 2000). The quantity of *Podocarpus* to be shipped annually from China is projected to fill ten to one-hundred 40-foot shipping containers. For this reason, this element is rated as Medium (2).

Risk Element 6, subelement 2: Survive Postharvest Treatment

Whole trees are not likely to receive postharvest treatments such as irradiation, methyl bromide, or steam sterilization because there is no harvest of the commodity, and the types of treatments that would kill pests are also likely to kill the trees. Like other post-harvest treatments, the presence of artificial media and/or pots requires specific testing to ensure the efficacy of any proposed post-harvest treatments (Paull and Armstrong, 1994). For this reason, all of the pests are rated High (3).

Risk Element 6, subelement 3: Survive Shipment

This sub-element evaluates the mortality of the pest population during shipment of the commodity. Shipments of *Podocarpus macrophyllus* are not likely to be refrigerated and may spend two to four weeks in maritime transit to the United States (Cargo Systems, 2001; AQIM, 2002). Direct air shipments will not take this long. Interceptions by PPQ of the various pests (on any host) is evidence that when these pests are present on transported plants (in passenger baggage, permit cargo, general cargo, ships stores, *etc*.) that they can survive the ambient transport conditions (PIN 309, 2003).

Insect pests are highly likely to survive these conditions, but could be killed by exposure to below-freezing temperatures if it exceeds a species specific duration (CPC, 2002; Lee and Denlinger, 1991; McKenzie, 1967; PNKTO #45, 1984; Rosen, 1990). A cold treatment of prolonged duration is anticipated to be detrimental to *Podocarpus macrophyllus* penjing plants. The fungal pathogens also are likely to survive shipment because the host tissue provides a food source and protected site for growth (Agrios, 1997). For all of the pests, the rating is High (3). If these pests are not present on the plants during growth and packaging, and are prevented from entering the packages of plants during shipment, then there are no populations that follow the pathway, and the survivability of these pests is no longer a factor.

Risk Element 6, subelement 4: Not Detected at Port of Entry

In general, careful inspection for the mobile life stages of insect pests can detect them despite the presence of life stages that are small in size (Carter, 1984; Borror *et al*., 1989; Hill, 1987; Rosen, 1990). The very high number of interceptions of these pests from any country and on any commodity confirms that trained inspectors can find insect pests in shipments (PIN 309, 2003). The risk rating is Low (1) unless otherwise noted.

Some pests, however, are more difficult to detect and are, therefore, rated High (3). The mealybug, *Rhizoecus hibisci*, feeds on the roots of its host (Williams, 1996) which will make interception more difficult unless there is destructive sampling. If present, the microscopic nematodes (*T. crassicaudatus*, *T. leviterminalis* and *X. brasiliense*) will swim in the water associated with the roots of the plants (Agrois, 1997; Williams, 1960; Zem, 1977; Zhang *et al*., 1995; Zhang *et al*., 2002) and remain undetected. The scale insects, *Ceroplastes japonicus* and, *C. pseudoceriferus* may escape detection at low population levels due to their cryptic nature (Borror *et al*., 1989; Rosen, 1990).

Large infestations of *Thrips palmi* are likely to be detected by the leaf symptoms (Martin and Mau, 1992), but small life stages, limited populations, or soil-borne life stages are likely to evade detection (CPC, 2002) so the rating is Medium (2). While stem and leaf spot symptoms are easily detected (Pirone, 1978), latent infections or dormant spores present on the plants will be undetected, so the rating for both fungi is Medium (2). Both of these fungi are in genera where latent periods occur (Agrios, 1997).

The snail, *Acusta ravida* is likely to be detected only if slime trails are present, but eggs and populations resident in the growing medium are likely to evade detection without destructive sampling (Anon., 2003; Burch, 1962; Godan, 1983; Lai, 1984). Due to the difficulty of detection, these pests are rated High (3). While symptoms of leaf spots are easily detected (Pirone, 1978), latent infections or dormant spores present on the plants will be undetected, so the rating for each fungus is Medium (2).

Risk Element 6, subelement 5: Imported or Moved To An Area Suitable for Survival
This sub-element considers the geographic location of likely markets and the chance of the commodity moving to locations suitable for the pest's survival. Plants for planting that arrive in the United States are distributed according to market demand. All of the pests are rated High (3) because non-cultivated, landscape and ornamental hosts are widespread throughout the United States and outdoor locations for the artificially dwarfed plants are likely to provide suitable habitats for the pests (Bailey *et al*., 1976; NRCS, 2003).

The warmer habitat preferred by *Thrips palmi* may not be met in exterior situations (Lewis, 1997), so establishment of populations outside of greenhouses and interiorscapes is unlikely for most of the territorial United States (Capinera, 2000; Tsai *et al*., 1995). The rating for *T. palmi* is Low (1).

Risk Element 6, subelement 6: Contact with Host Material
Lack of suitable hosts restricts the opportunities for pests to establish populations. While passive factors such as wind, water, or animals may aid in the dispersal of stages of the insect pests (Kosztarab and Kozar, 1988; Rosen, 1990), suitable hosts must be available to sustain a pest population over time. All of the arthropod pests are rated High (3), except for *T. palmi*, because these arthropod pests can become major problems affecting plants in greenhouses and interiorscapes (Short *et al*., 2001). Plants grown in indoor areas may appear widely separated from native host plant populations, but close proximity of outdoor plant populations to host material provides a pathway for pests to become established (Beardsley and Gonzalez, 1975). For *Thrips palmi*, contacting hosts also will require escape from the indoor setting and finding mates. Low population densities tend to produce only male offspring (arrhenotoky) leading to overall population decline (Lewis, 1997) so this pest is rated Low (1).

In contrast, the fungal pests with narrow host ranges, *Sphaerella podocarpi* and *Pestalosphaeria jinggangensis*, are rated Low (1) because *Podocarpus* is not a major component of ecosystems throughout the United States. The other two fungi, *Pestalotia diospyri* and *Phellinus noxius* are rated High (3) because of their broader host ranges. Reduced dispersal capability will limit the contact with host material for the nematodes (*Tylenchorhynchus crassicaudatus*, *T. leviterminalis* and *X. brasiliense*) because many of their hosts are not typically grown indoors in the United States, so contacting hosts will require escape from the indoor setting and subsequently finding a host. These pests are rated Medium (2). The mollusk, *Acusta ravida*, is rated High (3) because it is a non-specific feeder (Robinson, 2003) that can rapidly spread within greenhouses if proper sanitary practices are not followed.

Table 6. Risk ratings for the Pest Survival Potential and the Likelihood of Introduction.

Pest	Quantity Imported Annually	Survive Postharvest Treatment	Survive Shipment	Not Detected at the Port of Entry	Move to Suitable Habitat	Contact with Host Material	Likelihood of Introduction
ARTHROPODA	Medium (2)	High (3)	High (3)				
Neophylaphis burostris				Low (1)	High (3)	High (3)	High (15)
Ceroplastes japonicus				High (3)	High (3)	High (3)	High (17)
Ceroplastes pseudoceriferus				High (3)	High (3)	High (3)	High (17)
Fiorinia proboscidaria				Low (1)	High (3)	High (3)	High (15)
Lepidosaphes piniphila				Low (1)	High (3)	High (3)	High (15)
Lepidosaphes tubulorum				Low (1)	High (3)	High (3)	High (15)
Drosicha corpulenta				Low (1)	High (3)	High (3)	High (15)
Icerya seychellarum				Low (1)	High (3)	High (3)	High (15)
Rhizoecus hibisci				High (3)	High (3)	High (3)	High (17)
Cryptothelea variegata				Low (1)	High (3)	High (3)	High (15)
Thrips palmi				Medium (2)	Low (1)	Low (1)	Medium (12)
MOLLUSCA *Acusta ravida*	Medium (2)	High (3)	High (3)	High (3)	High (3)	High (3)	High (17)
FUNGI	Medium (2)	High (3)	High (3)	Medium (2)	High (3)		
Pestalosphaeria jinggangensis						Low (1)	Medium (14)
Pestalotia diospyri						High (3)	High (16)
Phellinus noxius						High (3)	High (16)
Sphaerella podocarpi						Low (1)	Medium (14)
NEMATODA *Tylenchorhynchus crassicaudatus* *T. leviterminalis* *Xiphinema brasiliense*	Medium (2)	High (3)	High (3)	High (3)	High (3)	Low (1)	High (17)

[1] Individual ratings are presented when there is variability within a risk element, otherwise a single rating applies to all of the pest organisms for that risk element.

F. Conclusion: Pest Risk Potential

The summation of the values for the Consequences of Introduction and the Likelihood of Introduction is the value for the Pest Risk Potential (Table 7). The following scale is used to interpret this total: Low is 11-18 points, Medium is 19-26 points and High is 27-33 points. This is an estimate of the risks associated with this importation, and reduction of risk occurs through the use of mitigation measures.

Table 7. Values for the Consequences of Introduction, the Likelihood of Introduction and the Pest Risk Potential.

Pest	Consequences of Introduction	Likelihood of Introduction	Pest Risk Potential
ARTHROPODA			
Neophylaphis burostris	Medium (12)	High (15)	High (27)
Ceroplastes japonicus	High (15)	High (17)	High (32)
Ceroplastes pseudoceriferus	High (15)	High (17)	High (32)
Fiorinia proboscidaria	High (15)	High (15)	High (30)
Lepidosaphes piniphila	High (14)	High (15)	High (29)
Lepidosaphes tubulorum	High (15)	High (15)	High (30)
Drosicha corpulenta	High (15)	High (15)	High (30)
Icerya seychellarum	High (15)	High (15)	High (30)
Rhizoecus hibisci	High (13)	High (17)	High (30)
Cryptothelea variegata	High (15)	High (15)	High (30)
Thrips palmi	High (14)	Medium (12)	Medium (26)
MOLLUSCA			
Acusta ravida	High (15)	High (17)	High (32)
FUNGI			
Pestalosphaeria jinggangensis	Medium (11)	Medium (14)	Medium (25)
Pestalotia diospyri	High (14)	High (16)	High (30)
Phellinus noxius	High (14)	High (16)	High (30)
Sphaerella podocarpi	Medium (11)	Medium (14)	Medium (25)
NEMATODA			
Tylenchorhynchus crassicaudatus	Medium (10)	High (17)	High (27)
T. leviterminalis	Medium (11)	High (17)	High (28)
Xiphinema brasiliense	Medium (11)	High (17)	High (28)

The Pest Risk Potential for all of the arthropod, mollusk and nematode pests is High, except for *Thrips palmi* which is Medium. The Pest Risk Potential for two of the fungal pathogens is High (*Pestalotia diospyri* and *Phellinus noxius*), while the other two fungal pathogens (*Pestalosphaeria jinggangensis* and *Sphaerella podocarpi*) are Medium. Pests with a Low Pest Risk Potential typically do not require mitigation measures other than port of arrival inspection. A value within the Medium range indicates that specific phytosanitary measures may be necessary. A rating in the High range indicates that specific phytosanitary measures, supplemental to port of arrival inspection, are strongly recommended. As a stand-alone mitigation measure for penjing plants, port of arrival inspection is insufficient to provide phytosanitary security for the quarantine pests analyzed in this document, and the development of additional specific phytosanitary measures is recommended.

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